

Code: 9A21804

1

B.Tech IV Year II Semester (R09) Regular Examinations, March/April 2013

**HELICOPTER ENGINEERING**

(Aeronautical Engineering)

Time: 3 hours

Max. Marks: 70

Answer any FIVE questions.  
All questions carry equal marks.

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- 1 Describe the different types of helicopters with proper sketches.
- 2 Explain the collective and cyclic pitch changes, how they are implemented and their requirements, with the help of neat sketches.
- 3 Explain vortex ring state, flapping hinge, vena contracta, flow reversal and pitch.
- 4 Write note on:
  - (a) Power coefficient.
  - (b) Ideal twist rotor.
  - (c) Figure of merit.
- 5 Derive an expression for the induced power of a helicopter in forward flight.
- 6 Explain how the stability of a helicopter is ensured in flight.
- 7 Explain the design and functioning of the different types of VTOL aircraft.
- 8 Explain the different types of ground effect machines, and their working.

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- 1 (a) Describe the forces acting on a helicopter.  
(b) Describe a compound helicopter.
- 2 (a) Define pitch and angle of attack of a helicopter blade.  
(b) Explain the tail rotor design and its requirements.
- 3 Using momentum theory, derive an expression for the thrust coefficient and power coefficient in hovering flight.
- 4 Define 'Figure of merit' and obtain an expression for it in terms of thrust coefficient and power coefficient.
- 5 Write notes on:  
(a) Tip losses.  
(b) Parasite power.  
(c) Effect of altitude on the performance of a rotor.
- 6 Explain how the longitudinal equilibrium of a helicopter is achieved, stating all the governing equations and explaining all the variables clearly. Draw a neat sketch showing the forces and moments.
- 7 Describe the forces acting on a VTOL aircraft in hover. How is VTOL different from a helicopter in this condition?
- 8 Write short notes on:  
(a) Lift of a hovercraft.  
(b) Hover height.  
(c) Forces on a hovercraft moving over a water body.

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- 1 Explain the following: Blade twist, Blade loading, Solidity factor, Coning angle, Feathering.
- 2 Explain the different controls of a helicopter, explaining the requirements.
- 3 What is hovering? Explain the flow of air over the blades in this condition. Derive an expression for the thrust of a helicopter in hover.
- 4 (a) Explain the features of a fully articulated rotor.  
(b) Define profile power and induced power.
- 5 Write notes on:  
(a) Reverse flow over the blade of a rotor.  
(b) Mach number effect on the thrust produced by a rotor.  
(c) Stall of a section of a blade, ways of avoiding it.
- 6 Explain how the lateral equilibrium of a helicopter is achieved, stating all the governing equations and explaining all the variables clearly. Draw a neat sketch showing the forces and moments.
- 7 Describe a VTOL aircraft and explain its functioning.
- 8 Explain the working of a hovercraft, explaining all the forces acting on it clearly.

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- 1 (a) Define rotor torque.  
(b) Describe the different types of main rotor system of a helicopter.
- 2 Explain the different types of hinges used in a helicopter, and their requirement.
- 3 Derive an expression for the thrust developed in hovering condition of a helicopter using blade element theory.
- 4 Using momentum theory, derive expressions for the thrust and power coefficients for a helicopter climbing vertically up.
- 5 Explain induced power, profile power and parasite power of a helicopter in forward flight.
- 6 Explain, with the help of neat sketches, the forces and moments acting on a helicopter in flight that affect the stability of the helicopter.
- 7 Describe a STOL aircraft and explain its functioning.
- 8 Write notes on:
  - (a) Aerodynamic forces on a hovercraft.
  - (b) Ground effect.
  - (c) Drag of a hovercraft on water.

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